ARCNETplus: Moving Up

The venerable factory floor network gets a face lift.

George M. Thomas

If you are an ARCNET user, you'll probably agree that for most applications it provided an elegant solution. It could support up to 255 nodes and transmit data at a rate of 2.5 Mbit/s with data packets containing up to 508 data bytes. When it was used with microcontrollers and earlier generation 16-bit microprocessors, its 2.5 Mbit/s data rate was hardly taxed. Its token-passing protocol provided one of the first deterministic performances for real-time factory floor networks.

But, to meet the needs of high-speed workstations, additional performance is required. It is time to upgrade to ARCNETplus. Why?

- A transmission rate of 20 Mbit/s,
- 4,224 byte data packets, and
- more efficient protocol handling.

These improvements equate to an eightfold increase in performance and speed over the original. ARCNET and ARCNETplus nodes can coexist on a single network and communicate with each other over standard media. ARCNETplus technology is currently available on an ISA-compatible bus board. The board incorporates an ARCNETplus protocol controller chip (APC) and a cable transceiver for twisted pair or coax, technology developed by Datapoint Corp.

The new version communicates with ARCNET nodes and hubs via an ARCNETplus hub. During a reconfiguration cycle over the network, the APC records whether each remote node is ARCNET or ARCNETplus. When a remote node is selected to receive a packet, the APC adjusts its transmission rate (2.5 Mbit/s or 20 Mbit/s) and signal characteristics to match the receiving node.

Figure 1 illustrates the proper network distribution using a combination of ARCNET and ARCNETplus hubs. ARCNETplus hubs act as signal repeaters for both ARCNET and ARCNETplus signals. In addition, this hub can sense the type of node or hub connected to each of its ports. The ARCNETplus hubs will distribute all ARCNET packets to all ports, but will not distribute any incoming ARCNETplus packets onto ports connected to ARCNET nodes or hubs. Instead, these ports will receive a starting delimiter.

During a data transfer from one node to another, all other nodes on the network sense that the network is active. Otherwise, the network would appear to have gone dead. It is necessary for the ARCNETplus hubs to send the starting delimiter during all transmissions to prevent a no-activity timeout by other nodes, which would cause them to generate a reconfiguration burst.

As you can see in Figure 1, each hub and node is numbered. ARCNET nodes 1 through 3 can transfer data to and from

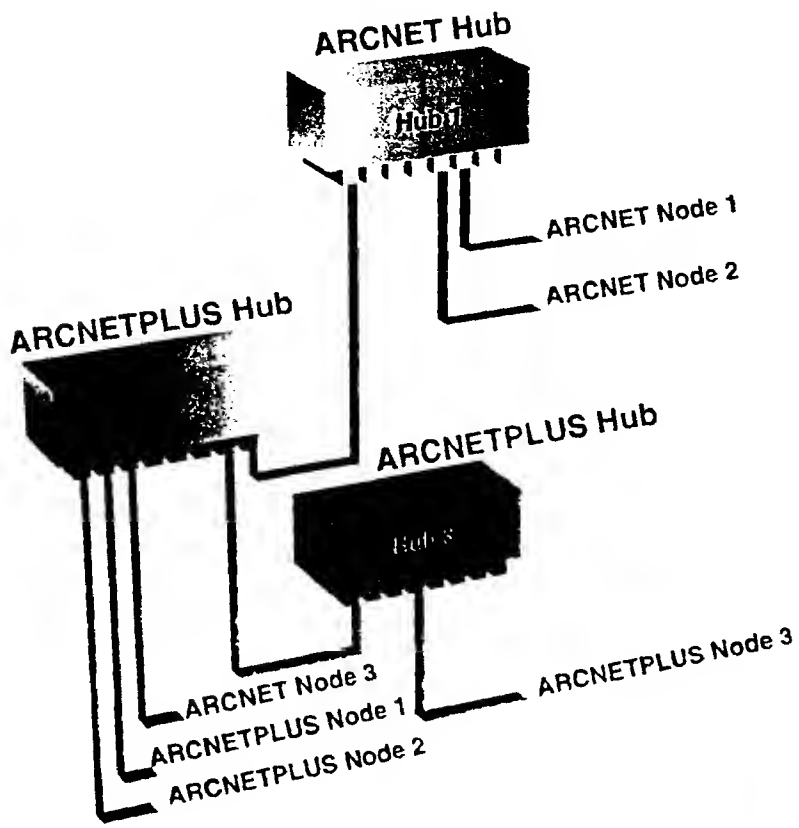

Figure 1. For any two ARCNETplus nodes to communicate at the ARCNETplus transmission rate of 20 Mbit/s, they must be connected through an ARCNETplus hub(s).

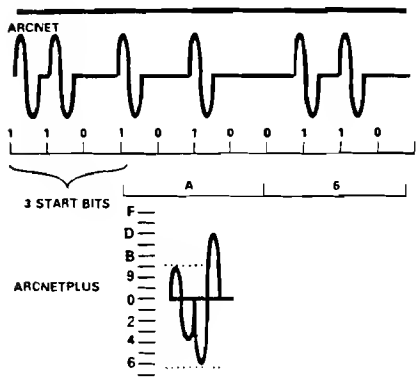

Figure 2. ARCNET vs. ARCNETplus signalling.

any node on the network, including ARCNETplus nodes 1 through 3, with standard ARCNET frames at 2.5 Mbit/s. ARCNETplus nodes 1 through 3 can transfer data to and from each other with the ARCNETplus frames at 20 Mbit/s. All ARCNET nodes will only receive a dummy frame during this time.

Remember, that each ARCNETplus node maintains a table of which nodes can receive an ARCNETplus frame. If ARCNETplus node 1 transmits an ARCNETplus frame, hub 2 will repeat that frame to the ports connecting ARCNETplus node 2 and hub 3. A dummy frame will be sent to the ports connecting ARCNET node 3 and hub 1. Thus, hub 1 will repeat the dummy file name to all of its ports, and hub 3 will repeat the ARCNETplus frame to ARCNETplus node 3.

A simple rule is that ARCNET hubs and nodes can be connected to either ARCNET or ARCNETplus hubs while ARCNETplus nodes can only be connected to ARCNETplus hubs. One suggestion is to group all ARCNET nodes, hubs, and bus segments together with one port of an ARCNET hub connected to a grouping of ARCNETplus nodes and ARCNETplus hubs via a port in the ARCNETplus hub. This arrangement simplifies the rules; however, you can always connect an orphan ARCNET node to an unused port on an ARCNETplus hub.

Cabling rules are the same for ARCNET and ARCNETplus. However, ARCNETplus only allows for star or distributed star wiring, whereas ARCNET also allows bus connections. For coaxial star wiring (-CXS), RG-62u cable is used up to a distance of 2000 feet before a hub must be encountered. For unshielded twisted pair wiring (-TPS), IBM type 3 cable is used up to a distance of 330 feet before a hub must be encountered.

ARCNET transmits at 2.5 Mbit/s while ARCNETplus transmits at 20 Mbit/s, yet this eight-fold increase in data rate must occur within the same signalling frame as ARCNET in order to maintain compatibility. This is accomplished using a clever multi-bit amplitude and phase-modulated cable transceiver.

An ARCNET bit frame is 400 ns long. However, a logic "1" is represented by a single dipulse 200 ns wide followed by 200 ns of silence. A logic "0" is represented by no activity. ARCNETplus activity operates on a nibble basis requiring a 200 ns bit frame. A four-bit nibble drives a digital to analog converter, which impresses a pseudo-sine wave with an amplitude and phase corresponding to the value of the nibble. (See Figure 2.)

On the receive side, the amplitude and phase is decoded and the four-bit nibble is captured. By doing the same thing during the normal silence portion of the ARCNET bit frame, another nibble can be sent and subsequently detected. Therefore, eight bits of data were received during the same time period required to send one bit of ARCNET. This eight-fold improvement translates to a 20 Mbit/s data rate.

The ARCNETplus ISA module can operate in either of two modes — native or emulation. When powered up, the module emulates a conventional SMC compatible (Standard Microsystems Corporation) ARCNET card with both an I/O map and a memory map and will function as a conventional low-speed ARCNET module. With the proper initialization, the module will enter its high performance ARCNETplus mode and will respond to enhanced commands. Of course, enhanced network driver software must exist to exploit the high performance of ARCNETplus.

Currently, an open device driver exists for Novell version 2.2 and 3.1 network operating systems. This driver will also function with Microsoft's Windows for Workgroups, Version 3.11. A NetBIOS driver that will allow existing NetBIOS systems to communicate with ARCNETplus is under development. **IC**

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Upgrading ARCNET

With A Kit From Grayhill

Grayhill's MicroDAC with fiber-optic cabling

Grayhill has developed a line of ARCNET upgrade kits, replacing MicroDAC's RS-422/485 serial port network with the higher speed ARCNET LAN while preserving the basic OPTOMUX protocol.

The published OPTOMUX command language is familiar to control engineers and third-party PC software vendors. Encapsulation of the OPTOMUX protocol within the ARCNET packet is compliant with the ANSI 878.3 standard proposed by the ARCNET Trade Association.

This "multimaster" communication, by taking the place of the basic RS-422/485 master/slave communication used to connect Grayhill's MicroDAC with a host computer, creates a true peer-to-peer distributed control system, according to Grayhill sources.

The MicroDAC is a small footprint microcontroller capable of controlling or monitoring a mix of up to 32 analog or digital single point I/O modules mounted on a companion input/output rack. Until now, commands to the MicroDAC had to originate from a single-host computer, generally a PC, to conform to the industry standard master/slave OPTOMUX protocol.

Each upgrade kit contains the appropriate ARCNET SBX board (fiber optic, coaxial or twisted pair cabling), source code for the interface driver, user's manual, and firmware chip.

ARCNET is a local area network capable of supporting 255 nodes with a 2.5 Mbit/s data rate. Its token-passing protocol allows any node to communicate with any other node on a peer-to-peer basis. Broadcast messages are also supported. The token continues to be passed in a logical ring fashion, serving all nodes on the network equally.